Since the diameter of contact-hole is in the order of microns or less, visible light can not illuminate the bottom of the contact-hole, so that it is difficult, to detect the state of the contact-hole optically. Therefore, SEM (Scanning Electron Microscope) suitable for analysis of a fine structure has been mainly used as a tester. In the SEM, a contact-hole region is irradiated with electron beam, which is accelerated to several tens keV and collimated to several nanometers, and secondary electron produced in the irradiated region is detected by a secondary electron detector, on which an image of the contact hole is formed. A specimen irradiated with <u>the</u> electron beam generates secondary [electron] <u>electrons</u>, an amount of which corresponds to constituting atoms thereof. However, the secondary electron detector in the SEM is usually arranged in a specific direction, so that a whole of produced secondary [electron is] <u>electrons are</u> not always detected. If the specimen includes irregularity in its structure, there is a case where secondary electron is not detected depending upon portions of the specimen, resulting in that contrast is produced in an image of the specimen under test, which is formed of a single substance. This is the feature of the SEM.

Please amend the paragraph on page 5, lines 6 to 20, as follows:

Further, it is possible to know a film thickness by measuring a substrate current. For example, JP P62-19707A discloses a technique in which a relation between a waveform of a substrate current, acceleration voltage of electron beam and a film thickness, when a pulsed electron beam irradiation is performed, is preliminarily obtained and a film thickness is obtained from a current waveform. measured by using electron beam accelerated with a certain acceleration voltage. Further, JP P2000-124276A discloses a technique in which a current, which is not a variation of current [wit] <u>with</u> time but a current value, produced by irradiating a test sample with electron beam and passed through the test sample to a backside surface thereof is measured. In a technique disclosed in JP 2000-180143A, a current flowing through a thin film to a substrate, is measured and a film thickness is obtained by comparing the measured current with a current value obtained for a

standard sample and JP P2000-164715A discloses a standard sample suitable for use in the technique disclosed in JP P2000-180143A.

Please amend the paragraph on page 6, lines 12 to 17, as follows:

The reason for the use of parallel electron beam in the present invention is that, when a converging electron beam is used, it is necessary to condense the electron beam to a vertical level of a measuring location and, so, it is not suitable in obtaining an information of the sample in a depth direction thereof. When a parallel electron beam is used, focal distance becomes infinite so that focus regulation becomes unnecessary.

Please amend the paragraph on page 7, lines 1 to 8, as follows:

The electron beam irradiation means includes an electron gun and the collimator means includes a condenser lens for collimating the electron beam emitted from the electron gun to a parallel beam and an aperture plate having an aperture inserted [into] between the condenser lens and the semiconductor device, for limiting a spot size of electron beam such that electron beam impinges an opening portion. The electron beam irradiation means preferably includes means for moving the sample under test with respect to electron beam in order to scan-the ample with electron beam.

Please amend the paragraph on page 12, lines 21 to 26, as follows:

The means for obtaining information related to the structure in the [dept] depth direction preferably includes means for obtaining a three-dimensional configuration of a through-hole provided in an insulating film by measuring values of current produced by irradiation of electron beam passing through a portion of the insulating film, which surrounds the through-hole, with increased acceleration voltage.

Please amend the paragraph on page 24, lines 7 to 10, as follows:

Since size of the contact-hole to be measured is very small, the sample 5 should be put on the stage 6 [in] flat. In order to realize such arrangement of the sample 5 on the stage 6, it may be effective to press an outer periphery of the [ample] <u>sample</u> 5 onto the stage 6 by using such as ring-shaped jig.

Please amend the paragraph on page 24, lines 19 to 25, as follows:

FIG. 2 is a block diagram of a semiconductor device tester according to a second embodiment of the present invention, which is suitable when a cross sectional area of electron beam [in] <u>is on the order of a</u> micron [order]. In this tester, an electron beam generation system includes an afocal system composed of a second condenser lens 15 and an objective lens 16 and constitutes an electron optics system for converting incident parallel beam into parallel beam having cross sectional area smaller than an aperture area of an aperture plate 14.

Please amend the paragraph beginning on page 26, line 18, and continuing to page 27, line 6, as follows:

FIG's. 6(a) and 6(b) illustrate the measuring method, in which FIG. 6(a) shows a structure of a contact-hole 43 to be measured and a measuring system therefor and FIG. 6(b) shows an example of a result of measurement. The contact-hole 43 is formed such that it penetrates an [m] insulating film 41 formed on an underlying substrate 42. The insulating film 41 may be an oxide film or a nitride film, etc. In a good, that is, normal contact-hole, a surface of the underlying substrate 42 or a surface of a wiring layer formed below the insulating film is exposed. Electron beam 31 having a diameter in the order of 100Å and generated by the tester shown in FIG. 1 or <u>FIG.</u> 2 is vertically directed to a sample having the contact-hole 43 formed therein while scanning it horizontally. Acceleration voltage and current of electron beam 31 are set to in a range from 0.5kV to several kV and several nA, respectively. When electron beam 31 passes through the contact-hole 43 down to the underlying substrate 42, current flows through the underlying substrate 42. The current is referred to as "compensation current". FIG.

6(b) shows compensation current produced when the sample is scanned by electron beam in a horizontal direction along a center line of the contact-hole 43.

Please amend the paragraph beginning on page 29, line 19, and continuing to page 30, line 7, as follows:

FIG's. 10(a) and 10(b) illustrate a measurement of a contact-hole by using electron beam of which cross sectional area is larger than the aperture of the hole, in which FIG. 10(a) shows a structure of a contact-hole to be measured and a measuring system therefor and FIG. 10(b) shows an example of a result of measurement. FIG's. 11(a) and 11(b) illustrate a measurement of a tapered contact-hole by using electron beam of which cross section area is larger than the aperture of the hole, in which FIG. 11(a) shows a structure of the contact-hole to be measured and a measuring system and FIG. 11(b) shows an example of a result of measurement. In each of the measurements, the electron beam generator shown in FIG. 1 or FIG. 2 is used and a cross sectional area of the electron beam is set to a value (for example, several microns square) larger enough than an area of the contact-hole. Compensation current is measured under condition that a sample is vertically irradiated with electron beam such that a whole bottom of the contact-hole thereof is irradiated simultaneously with the electron beam. An electron beam source is preferably capable of emitting electron beam whose intensity distribution within a cross sectional beam area is as flat as 1% or less.

Please amend the paragraph on page 30, lines 8 to 17, as follows:

When a whole contact-hole 43 or 44 is irradiated with electron beam 51 at once, compensation current produced in an exposed portion of an underlying substrate 42 is measured by an ammeter 9 at once. Since the secondary electron emitting efficiency is specific to substance to be irradiated with electron beam, an amount of compensation current in unit area of the region in which the underlying layer is exposed is constant throughout the region if electron beam irradiation condition is the same. Therefore, when the whole bottom of the contact-hole 43 or

44 is irradiated with electron beam 51, compensation current, which is proportional to the bottom area of the contact-hole 43 or 44, is observed as shown in FIG. 10(b) or FIG. 11(b).

Please amend the paragraph on page 33, lines 12 to 25, as follows:

A method for determining compensation current per unit area when the standard sample having a contact-hole whose bottom area is known can not be prepared will be described with reference to FIG's. 12(a) and, 12(b). In the method, electron beam 52, which is sufficiently thinner than an opening area of a contact-hole of a sample and has a known spot size, is vertically directed into the contact-hole. Since the spot size of electron beam produced by the tester shown in FIG. 1 or FIG. 2 is restricted by size of the aperture forming in the aperture plate, it is possible to obtain the size of the electron beam by calculation. In order to further improve the accuracy of measurement, the diameter of electron beam is directly obtained by the knife edge method, etc. When such electron beam is directed to a standard contact-hole, compensation current such as shown in FIG. 12(b) is measured. A compensation current per unit area of the standard contact-hole is obtained by dividing the thus obtained compensation current by the spot size of electron beam.

Please amend the paragraph on page 36, lines 15 to 24, as follows:

When the information is displayed on the image display device with using the compensation current value or the diameter of the opening portion of the contact-hole as a reference, there may be a case where luminance is too high or too low, causing an image on a screen to be hardly looked. Therefore, it is necessary to correct the image display to thereby make the displayed image easily visible. As a correction method of the image display, a regulation of luminance on the basis of a center value may be considered, for example. Further, since defective products is more important than good products in fabrication process, it is preferable to make an information of defective product easier to [look] see.

Please amend the paragraph on page 40, lines 4 to 11, as follows:

As electron beam scanning a periphery of the contact-hole and an interior thereof, the parallel electron beam obtained by the tester shown in FIG. 1 or FIG. 2 is utilized. When a converging electron beam is used, it is necessary to regulate a focus of the beam to a vertical position which is different between a case where the periphery of the contact-hole is scanned and a case where the bottom of the contact-hole is scanned. However, when the parallel electron beam is used, the focal length becomes infinite and, therefore, there is no need of focus regulation.

Please amend the paragraph on page 42, lines 5 to 15, as follows:

FIG's. 16(a) and 16(b), 17(a) and 17(b) and 18(a), 18(b) and 18(c) illustrate examples of measurement of a cylindrical contact-hole, a tapered contact-hole and a reverse-tapered contact-hole, respectively, in which [FiG's.] FIG's. 16(a), 17(a) and 18(a) shows structure of the respective contact-holes and measuring systems therefor, FIG's. 16(a), 17(b) and 18(b) show amounts of secondary electron (upper lines) and amounts of measured compensation current (lower lines) with respect to positions irradiated with electron beam. [It] Deviations between measuring points of secondary electron and compensation current caused by the slanted incident beam are corrected to the positions of the contact-holes. FIG. 18(c) shows a three-dimensional configuration of a restored reverse-tapered contact-hole.

Please amend the paragraph beginning on page 45, line 28, and continuing to page 46, line13, as follows:

FIG's. 20(a) and 20(b) [shows] show an example when dust 72 is deposited on a bottom of a tapered contact-hole 44. When the scanning of the sample with vertical thin electron beam 31 is started from a left side position in FIG. 20(a), compensation current is not observed during a time for which electron beam 31 irradiates an insulating film 41 surrounding the contact-hole 44. When electron beam 31 irradiates the tapered portion, no compensation is detected since

the thickness of the insulating film is large. On the other hand, when electron beam 31 reaches an edge of the contact-hole 44, compensation current is detected. Although a constant compensation current is detected for a time for which electron beam 31 irradiates a bottom of the contact-hole 44, no compensation current is observed when electron beam 31 irradiates the dust 72. Existence or absence of dust or size of dust can be obtained by comparing the result of measurement with a result of measurement performed for a contact-hole having no dust.

Please amend the paragraph on page 46, lines 14 to 26, as follows:

FIG's. 21(a) and 21(b) [shows] show an example when dust 73 exists on a center portion of a bottom of a reverse-tapered contact-hole 45. When the scanning of the sample with electron beam 31 is started, compensation current is not observed during a time for which electron beam 31 irradiates an insulating film 41 surrounding the contact-hole 45. When electron beam 31 reaches the bottom of the contact-hole 45 large compensation current is detected. When electron beam 31 reaches the dust 73, no compensation current is detected. When electron beam 31 passes over the dust 73 and irradiates the bottom of the contact-hole 45, compensation current is detected again. When electron beam 31 reaches an edge of the contact-hole 45, no compensation current is detected. The position of the sample, at which no compensation current is detected, corresponds to a region in which the dust 73 exists and the size of the dust 73 can be estimated from a width of this region.

Please amend the paragraph on page 47, lines 12 to 17, as follows:

[FIG.] FIG's. 22(a), 22(b) and 22(c) illustrate an example of measurement utilizing electron beam having a large cross sectional area, in which FIG. 22(a) is a plan view showing a relation between a contact-hole 81 and electron beam 82, FIG. 22(b) is a cross section thereof and FIG. 22(c) shows compensation current obtained with respective to compensation current obtained with respect to the scanning position of electron beam and a differentiation thereof.